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Influence of Industrial and Abattoir Wastes on Some Physicochemical and Bacteriological Variables of Aba River Nigeria

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Abstract

The Aba River in Abia State Nigeria was investigated to determine the influence of industrial and abattoir wastes on some physicochemical and bacteriological characteristics of the system for its monitoring. The study was carried out in the wet season month of June, 2012 and standard methods were adopted for field and laboratory studies. The parameters analyzed from water samples were as follows: Nitrate, Phosphate, Conductivity, Salinity, pH, Iron, Calcium hardness, Magnesium hardness, Copper, Ammonia, Calcium, Magnesium, Turbidity, Chloride, Sulphate, Alkalinity, Nitrate- Nitrogen, Manganese, Dissolved Oxygen, BOD, Total Suspended Solid, Detergents, Oil and Grease, COD, Feacal Coliform, Total Coliform and Total Hetrotrophic count. The comparison of the result with WHO standard showed that Nitrate, TDS, TSS, Copper, Iron, Feacal and Total Coliform counts exceeded the allowable limits especially at the *Nigerian breweries*. This may limit growth and lead to the death of many aquatic life forms or make the fish to migrate to more habitable zones. The abattoir station is slightly acidic (pH = 5.9) showing organic pollution and elevated values of coliform indicate feacal contamination. The low value of BOD showed that at wet season the increased volume of water apparently diluted the concentration of industrial and abattoir wastes. The Aba River is grossly polluted by the industrial activities and cannot be used in this form for any domestic purpose without treatment.

Key Words: Aba River, Physicochemical, Bacteriological, Parameter.

INTRODUCTION

Water pollution occurs when pollutants are discharged directly or indirectly into water bodies without adequate treatment to remove harmful compounds (Ajayi and Adeleye, 1997). The effect is damaging not only to individual species and populations, but also to the natural biological communities, and it accounts for the deaths of more than 14,000 people daily (WHO, 2007). Water quality refers to the physical, chemical and biological characteristics of water (Adeyeye, 2000). It is a measure of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose (Babich and Stoczky, 1985). In Aba River, effluents discharged into receiving waters and the cumulative hazardous effects on the environment have received much attention due to rapid industrialization of the area. High concentration of pollutants is usually common in water bodies close to production companies and local villages as in the case of Aba River. Industrial and abattoir wastes containing high concentration of microbial nutrients promote an after growth of significantly high coliform type and other microbial forms, both in the effluents and the receiving waters (Laws E.A., 1981). This work was carried out in order to establish the existing levels and assess the pollution profile, as well as to examine the assimilative capacity of the water body in Aba River. Similar studies have been conducted in the Lagos Lagoon, Igboba River in Benin and in Niger/Delta River (Odeyemi, 1985, Offorbuike et al. 2004).

STUDY AREA.

Aba is a developing industrial and agricultural city in the Abia State of Nigeria. Aba lies between latitude $5^{o}05^{l}$ to $5^{o}30^{l}$ North and longitude $7^{o}15^{l}$ to $7^{o}40^{l}$ East in Abia State of Nigeria and is characterized by relatively low elevation and near flat topography which enhances its runoff. Aba River is a tributary of Imo River and is the major river that passes through Aba town; and it is an important economic river in Abia State. The river originates from the northern Ngwa hinterland of Aba and stretches down to Cross River state where it empties with its creeks into the Atlantic Ocean. The River flows in North-South direction and joins the Imo River. The river is recharged by precipitation and groundwater. The river is used for various human activities including car washing, domestic uses, rearing of farm animals and fishing. It receives wastes from the industries for example Nigeria breweries Ltd, Paterson Zochonis (PZ) and abattoirs sited along its course. The study area is part of the Niger Delta Basin and is underlain by the Benin Formation of Miocene to recent age. The formation is made up

of very fine to coarse grained sand with minor intercalations of clay and gravel. The Benin Formation in Aba is composed mostly of high resistant fresh water bearing continental sand and gravel with clay and shale intercalations. The general thickness of the Benin Formation is variable and ranged from 200m at the North-East end to about 2000m at the South-West .The vegetation appears more forest-like along river channels and due to intense farming in the area, grasses are taking over the original tropical forest characteristic of the area.

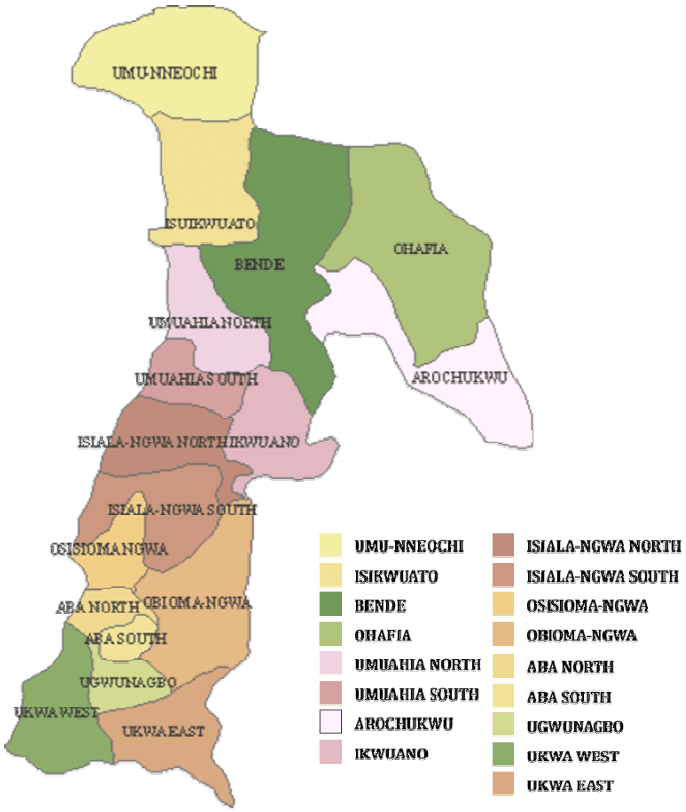

Fig. 1.0 Map of Abia State showing the local governments. ***Source: Goggle 2012***

METHODOLOGY

SampleCollection.

The water samples were collected in 1liter clean plastic containers, from five different locations: Upstream, Nigerian Breweries, PZ and Downstream. The containers were filled without agitation and air contact with the samples avoided. They were transported in a cooler to the UNIDO/IGCC Regional Activity Center for Environmental Pollution Monitoring and Assessment laboratory , Owerri , Imo State for analysis.

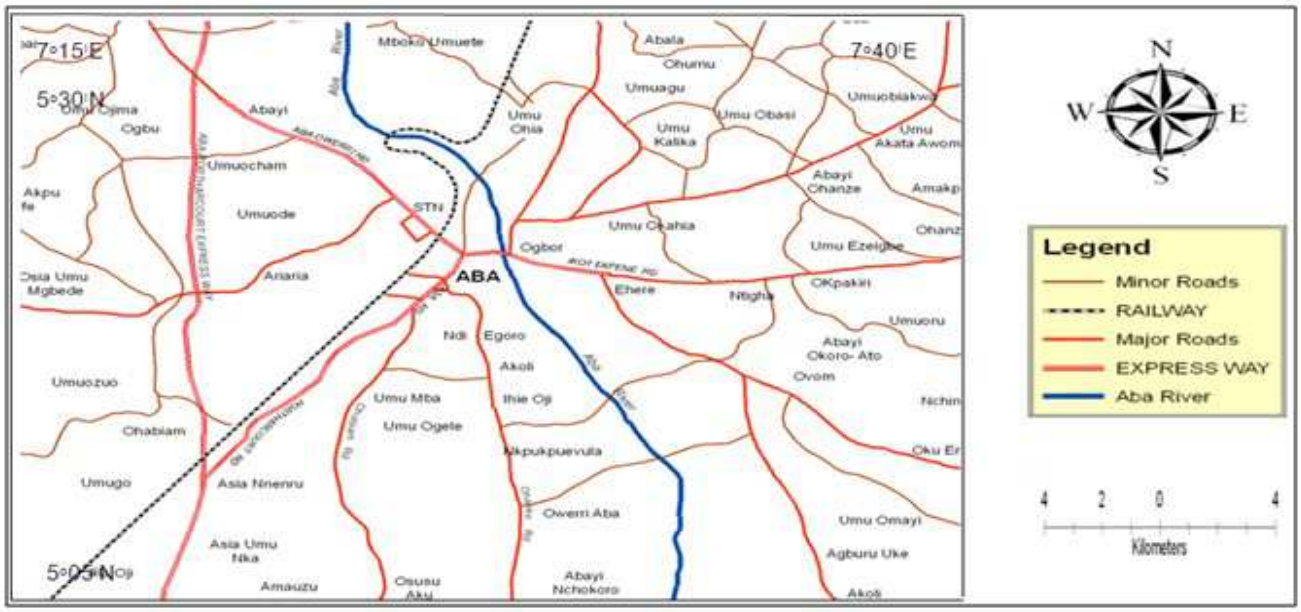

Fig 2.0 Map showing the course of Aba River. ***Source: Goggle 2012***

Plate 1: Disposal of brewery effluents into Aba river.

Plate 2: Pipes leading to treatment plants at PZ factory.

Plate 3: Use of water for domestic purposes in the study area.

Plate 4: Washing of sack bags at the bank of the river during industrial activities

Plate 5: Animals for slaughter at the abattoir in the study area.

Method of Analyses.

Analyses were carried out on the water samples for their physiochemical properties and microbiological properties. The concentrations of Electrical Conductivity and Total Dissolved Solid were determined using conductivity/ TDS probe Meter. Colour was determined by spectrophotometer at wavelength 455nm.Nitrate,Iron and copper were determined using Datalogging spectrophotometer at wavelengths 400nm,265nm and 560nm respectively. Alkalinity was measured using colorimetric method. Ammonia was determined by Nessler Method which produces a yellow tint as ammonia reacts with reagents. Calcium hardness, Magnesium hardness, Manganese, Phosphate and Sulphate were determined photometrically at their respective wavelengths. Total Suspended Solid (TSS) and Turbidity were determined by photometric method at wavelenghths of 810nm and 860nm respectively using HACK DR/2010 Spectrophotometer.BOD was determined by Winkler method while DO was determined using DO meter probe.pH and Temperature were determined using Suntex probe meter. The total coliform count,feacal coliform count and total heterotrophic count were determined by spread plate count after serial dilution and cultivation.

RESULTS

The results of the water analyses for samples from the upstream, PZ discharge point, Nigerian Breweries discharge point, abattoir and downstream were compared with the World Health Organization acceptable standards for surface water. The tabulated results were presented below:

Bacteriological Analyses Result

Sample	Total heterotrophic count (cfu/ml)	Mean	Total coliform (mpn/100ml)	Mean	Feacal coliform (mpn/100ml)	Mean
Abattoir	6.2×10^2 to 4.2×10^3	2.4×10^3	20 to 35	28	40 to 30	35
Downstream	3.4×10 to 1×10^2	6.7×10	8 to 9	9	4 to 6	5
PZ	5.0×10 to 1×10^2	0.75×10^2	2 to 3	3	2 to 4	3
NB ltd	6.6×10^3 to 4.3×10^4	2.8×10^4	85 to 92	89	35 to 42	39
Upstream	2.4×10 to 4.8×10	3.6×10	1 to 2	2	1 to 2	2
WHO/FMENV STD	5 to 10		0		0	

Cfu/ml – colony forming unit per milliliter.
MPN/100ml – Most Probable Number per 100 Milliliter.
WHO – World Health Organisation
FMENV – Federal Ministry of Environment
STD – Standard

Physiochemical Analyses Result

s/n	Parameters	WHO/FM ENV. STD.	Upstream	PZ	NB ltd	Abattoir	Downstream
1	Copper (mg/l)	1.0	0.62	1.83	2.12	2	1.24
2	Iron (mg/l)	0.3	0.7	0.88	0.84	1.59	0.89
3	Calcium hardness (mg/l)	-	2.5	1.24	18.26	6.8	2.65
4	Magnesium hardness (mg/l)	-	0.46	1.12	6.55	5.9	2.48
5	Ammonia (mg/l)	-	3	13	64	36	22
6	Colour real (PCU)	15	13	84	1132	125	100
7	Calcium (mg/l)	-	1.4	3.67	7.4	5.6	6.2
8	Magnesium (mg/l)	-	0.18	0.06	0.04	0.04	0.08
9	Turbidity (NTU)	50	73	231	440	340	197
10	Chloride (mg/l)	250	12.5	48.6	70.8	30.4	22.1
11	Nitrate (mg/l)	45	35.2	47.4	159.8	55	45.2
12	Sulphate (mg/l)	250	30	85	160	120	95
13	Alkalinity (mg/l)	-	70	100	255	110	90
14	Phosphate (mg/l)	100	4.6	12.3	42.5	12.9	8.4
15	Nitrate-nitrogen (mg/l N)	10	7	10.8	36.5	12.6	10.3
16	Colour (PCU)	-	176	469	3530	676	159
17	Manganese (mg/l)	-	0.3	1.8	1.6	2.8	2.3
18	DO (mg/l)	>4	8.7	8.2	6.9	7	7.6
19	Conductivity (µs/cm)	100	21.5	30.5	691.5	41	98
20	TDS (mg/l)	250	13	27	417	22	59
21	Temperature (^{o}C)	25 to 30	24.8	25	32	29	30
22	pH	6.5 to 8.5	6.1	6.0	10.6	5.9	9.1
23	BOD (mg/l)	40	1.1	2.9	4.1	2.8	2.2
24	TSS (mg/l)	10	15	110	780	324	184
25	Detergent (mg/l)	15	0	8.4	0.7	2	1.6
26	Oil and grease (mg/l)	10	0	0.3	2.2	3.5	2.8
27	Salinity (%)	-	0	0	1	0	0
28	COD (mg/l)	120	1.76	4.64	6.56	4.48	3.52

WHO – World Health Organisation
FMENV – Federal Ministry of Environment
Mg/l – milligram per liter
PCU – cobalt platinum standard unit
µs/cm – micro siemens per centimeter
NTU – nethelometric turbidity unit
^{o}C – degree celcius
% - percentage

DISCUSSION

Nitrate ranged between 35.2mg/l (upstream) and 159.8mg/l at Nigerian Breweries station. Nitrates can be harmful to humans if they exceed acceptable limits because our intestines can break them down into nitrites which affect the ability of red blood cells to carry nitrogen (M C Neely et al, 1979). Nitrates can also cause serious illness in fish. Nitrates levels exceeded safe limits at abattoir station and Nigerian Breweries. This agrees with the work of Umunnakwe , (2007) and Oladeji, (2001). Notable sources of nitrate are sewage, plant materials, municipal wastes, abattoir wastes and brewery waste water (Sutcliffe et al, 1982). The pH level levels are normal at all the stations but slightly acidic at the abattoir station (5.9). Water containing high organic content e.g. abattoir wastes tends to be acidic (Cude, 2001). High alkaline value at Nigerian breweries may be due to caustic soda used in breweries operation. The turbidity ranged between 73NTU and 440NTU and exceeded the allowable limits of WHO Standard. At high turbidity levels, water loses its ability to support diversity of aquatic organism due to obstruction of light (Lutz, 2004). The suspended solids will smoother the habitat and fatally clog fish gills and abrade the exposed membranes of aquatic organisms. The high levels of Total Suspended Solids and Total Dissolved Solids may be associated with high level of turbidity of Aba River. The isolation of Coliforms and bacteria implies contamination of the river by human activities, sedimentation

and depuration. The levels of phosphate are within acceptable limits and there may not be danger of enrichment leading to eutrophication. The levels of BOD and DO are within acceptable limits. The detection of elevated levels of other measured parameters is not known to pose serious environmental problems to the river.

CONCLUSION AND RECOMMENDATION

The results obtained from the analysed samples, showed that the values of Biochemical Oxygen Demand, Chemical Oxygen Demand, Dissolved Oxygen, Chloride, Sulphate, Phosphate, Detergent and Oil And Grease at all sampled locations were within the limits set by World Health Organization for surface water. However, the microbiological parameters, nitrate, iron, turbidity and total suspended solids and copper exceeded the permissible standard of World Health Organisation for surface water. The water quality of Aba River is not fit in this present form to serve the domestic purpose of drinking, washing, cooking for the local inhabitants without further treatment. It is recommended that the river undergoes regular monitoring.

REFERENCES

Adeyeye, E.I., (2000). *Determination of Major Elements in Fish, Associated Water and soil sediments from some freshwater ponds,* Ghana: J. Chem Publishing Company, pp322-327.

Ajayi S.O. and Adeleye S.A.(1977). 'Pollution studies on Nigeria Rivers I:Preliminary report on the pollution level of the River Ona and Ogunpa'. *Bull Chemistry Society of Nigeria handbook,* 25, pp 40 and 44.

Cude, C., (2001). 'Interpretation and Communication of Water Quality Data Using the Oregon Water Quality Index'. Oregon Department of Environmental Quality Laboratory Division. Oregon, USA.

Laws .E.A. (1981). *Aquatic pollution*. New York: John Wiley and Sons, pp 27-39.

Lutz, S.D. (2004). 'Calculating the national sanitation foundation water quality index'.*http://www.cce.iastate. edu/research/Luz/dmrwqn/water quality index calc. Htm*

McNeely, R.N., Neimanis V.P. and Dwyer, L. (1979). Water Quality Sourcebook (*A Guide toWater Quality Parameters*). Inland Waters Directorate Ottawa, Canada. pp 32 – 70.

Offorbuike J.O.,Ibekwe V. I.,and Nwaiwu O.I. (2004). 'Bacteriological and physicochemical qualities of wastewater'. *Global J. Environmental* Abuja: 3,pp 34-35.

Okoronkwo N.and Odeyemi. O. .(1985). *Effect of a sewage lagoon effluent on the water quality of the receiving stream*. Akure: Stilllo Publications, p 9

Oladeji, O.S., (2001). 'Preliminary assessment of the environmental impacts of landusepatterns on groundwater quality'. *Global Journal of Environmental Sciences.* pp 35 – 42.

Stoczky .G. and Babich. H., (1985). *Heavy metals toxicity to microbe mediated ecologic processes: A review and potential application to regulatory policies*. Germany: Kaymax publishers,p I67.

Sutcliffe, D.W., Heron, T. R., Carrick J., Riggs, E. and Lund, J.W.D. (1982). 'Long-term and seasonal changes in the chemical composition of precipitation and surface waters of lakes in the English lake district.' *Freshwater Bio*. 12(1). pp451 – 506.

Umunnakwe, J.E., (2007). Development of a Water Quality Index to Assess the Impact of Port Harcourt Abattoir on the Woji Creek. *An M.Phil thesis submitted to Rivers state University of Science and Technology,Port Harcourt.*

WHO,World Health Organization.,(2007). *Guideline for surface water quality. Health Criteria and other supporting information,* Geneva: pp264, 400. Environmental Protection Agency, *Quality Criteria for Water,* USEPA, Washington DC: pp169-173.